

**Improving Adolescents' Cognitive Operations to Drive Better Decisions,  
Health, and Well-Being**

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## **Abstract**

Certain aspects of social media use present significant challenges to adolescent well-being, affecting mental and physical health, academic performance, and social behavior. This paper explores interventions to address cognitive biases that contribute to excessive social media use in adolescence. Building on Tversky and Kahneman's dual-process theory, proposed interventions include social norm nudging, community-based approaches, and precommitment strategies. These interventions aim to address adolescents' sensitivity to rewards and peers to ultimately enhance decision-making and reduce problematic social media use. Additionally, this paper underscores the need for critical thinking curricula and developmental adaptations of tools like the Cognitive Reflection Task to foster better decision-making skills in adolescents, ultimately promoting their health and well-being.

## **Combatting adolescents' cognitive biases to reduce social media use**

The rapid evolution of technology and social media use has significant implications for adolescents, spanning educational opportunities, leisure activities, community building, online bullying, and ethical concerns associated with the rise of artificial intelligence and content algorithms. Notably, social media has given adolescents unprecedented access to immediate gratification and entertainment. While these technological advancements can be enriching in many ways, there are also significant risks posed to adolescent mental health, physical health, and implications for academic performance (Shensa et al., 2017).

So, in a world of access to immediate gratification through online avenues, how can we encourage adolescents to make effortful, thoughtful choices about their time? What are effective interventions for parents, teachers, and community members to reduce excessive adolescent social media usage, and encourage academic or personal enrichment, physical health, and mental well-being? The answers may lie within the field of decision education, or the teaching and learning of skillful judgment formation and decision making across four K-12 learning domains: thinking probabilistically, valuing and applying rationality, structuring decisions, and recognizing and resisting cognitive biases (Alliance for Decision Education, 2023). This paper will focus on the domain of cognitive biases within the practical context of social media. It will concentrate on adolescents, emphasizing proposed behavioral interventions for reducing cognitive biases associated with social media use. The ultimate goal of these interventions is to improve adolescent health and well-being.

## **Cognitive operations and the adolescent mind**

Amos Tversky and Daniel Kahneman laid the academic foundation for human judgements and decisions through a series of influential papers focused on heuristics and biases.

They posited that judgements under uncertainty rely on a series of mental shortcuts rather than rational algorithmic processing upheld by previous economic models (Kahneman 2003). They underlined three central heuristics - availability, anchoring and adjustments, and representativeness - that characterize judgements under uncertainty. The systematic errors that can arise from these heuristics are known as *biases*. Relatedly, dual-process theories such as those proposed by Kahneman and Tversky distinguish cognitive operations between System 1 and System 2 thinking. System 1 operates intuitively and automatically, while System 2 is reflective, controlled, and effortful. Under this dual-system model, cognitive biases in judgment stem from errors in System 1 judgements, necessitating the activation of System 2 to detect and correct these errors. Behavioral science interventions can be an effective way to activate system 2 thinking, thereby recognizing and overriding common cognitive biases (Kahneman 2003).

Understanding cognitive biases for adolescents is complemented through understanding the unique neural characteristics of this stage of life. Adolescence comes with significant structural and functional brain reorganization (Konrad et al., 2013). Neural regions for motivation and affect are hyperactive, making adolescents more susceptible to reward-seeking, especially from peers (Meshi et al., 2015). The adolescent brain is also highly plastic, which facilitates development but also poses risks for harmful influences. Neuroimaging research has shown that social media activates the reward circuitry of the brain, providing an unprecedented, constant stream of social inputs to adolescents during a period in which they are especially vulnerable to rewards and punishment (Maza et al., 2023). The prefrontal cortex, an area of the brain critical for executive function, matures last in adolescence, leading to difficulties with impulse control, risk-taking, and other hallmarks of adolescent behavior (Meshi et al., 2015).

**Problem statement: adolescents and the dark side of social media**

While this paper focuses on problematic social media usage as a prescient societal issue facing adolescents, it's important to acknowledge that cognitive biases can lead to a variety of other problematic behaviors. The Decision Education Research Agenda developed by expert scholars in the field of judgment and decision making emphasizes the importance of tying decision education to key life outcomes (Alliance for Decision Education, 2023). The study of reducing cognitive biases in adolescents is particularly well suited to this agenda, as excessive adolescent social media use may be an indicator for mental well-being, general health, and academic achievement, as detailed below.

For adolescents, social media use has been on the rise since 2014 (Vogels et al., 2022). Pew Research Center's 2022 report on social media found that 35% of a representative sample of 1,316 teens reported using one of the top five platforms "almost constantly." Moreover, 54% of teens said that social media would be at least somewhat hard to give up, and 95% of teens have access to a smartphone compared to 73% in 2014.

Despite its potential for connection and information-sharing, a growing body of research demonstrates instances of children, adolescents, and adults being affected by problematic social media use (PSMU). PSMU is characterized as a maladaptive pattern of social media use that includes excessive concern about social media and devoting time to social media at the impairment of social activities, studies/jobs, interpersonal relationships, and/or psychological health and well-being (Shensa et al., 2017). PSMU has been associated with problems in all six facets of emotional regulation, procrastination, and stress, as well as impulse control difficulties and procrastination. While there are some contradictory findings on the link between social media use and depression, PSMU has been found to be strongly and independently associated with depressive symptoms in adolescents (Shensa et al., 2017).

Additionally, increased social media use exposes adolescents to more online aggression, including cyber-bullying (Craig et al., 2020). Adolescents are vulnerable to group norms in their social environment, and they may observe the positive social awards of cyberbullying and act accordingly, creating threats of normalization and a self-perpetuating cycle. A cross-national analysis across adolescents in 42 countries found modest to strong links of problematic social media use to cyber-bullying and cyber-victimization (Craig et al., 2020). Given the associated threats to mental and physical well-being, these findings merit interventions to protect adolescents' health.

Finally, social media use in adolescents might be particularly important to address in light of learning gaps that have arisen from the pandemic. The National Center for Education Statistics' data on U.S. student performance in 2020 and 2022 demonstrates the largest reading score decline since 1990, and the first ever mathematics score decline ("Long-Term Trend Reading," 2022). On a global scale, pandemic-related learning loss is expected to negatively impact annual GDP by at least 1.5% for the rest of the century (Williams et al., 2023). It is thought that mental well-being is at least one driver of these decreased indicators of student performance.

### **Cognitive biases that pertain to social media use**

To create a successful behavioral intervention, it's critical to understand the underlying mechanisms that drive excessive social media use in adolescence. Adolescents are especially susceptible to *social norms* or models of peer behavior, which may lead to poorer decision making (Konrad et al., 2013). Adolescent susceptibility to social norms is inclusive of both negative and positive consequences. On the positive side, adolescents are less likely to engage in risky behavior if a friend discourages them, more socially influenced than adults to engage in

prosocial behaviors, and more likely to volunteer if their peers do (Andrews et al., 2020).

Additionally, van Hoorn (2016) found that young people aged 12–16 years give more generously in an experimental public goods game when they observe peers being generous. On the negative side, adolescent problematic usage of social media, poor academic performance, and risk-taking may be strongly influenced by behaviors of peers (Shensa et al., 2017; Konrad et al., 2013).

Another way of thinking about adolescents' susceptibility to peer influence, risk taking, and inhibited executive function that makes them especially vulnerable to harmful influences is through the bias called *present bias*. Present bias is the tendency to favor immediate, smaller rewards over larger, future rewards (Bisin et al., 2020). Present bias leads to obstacles in performing planned actions, leading to activities such as procrastination. Present bias leads to a systematic discounting of our future selves and is an automatic "System 1" process (Kahneman 2003). While behavioral biases are distinct from neural mechanisms, a nascent and promising area of future study might be present bias in adolescent populations. Researchers might examine if present bias correlates with inhibited executive functioning, which is often involved in planning and decision making, and/or problematic social media use. The section below will propose interventions for combatting present bias and peer influence that could be widely applicable in the context of problematic social media use.

## **Implications and interventions**

### **I. Social norm nudging and community based interventions**

Norm nudging involves eliciting social expectations to induce desirable behavior, operating under the assumption that individuals' preferences for performing the target behaviors are based on social expectations (Bicchieri & Dimant 2023). Social norms are classified as either *descriptive* or *injunctive*, and are based on either empirical expectations of others' behavior or

both empirical and normative expectations, respectively. To avoid backfiring of empirical nudges, it's critical to (a) include a relevant reference network and (b) ensure the messenger is trusted to lead to increased norm compliance (Bicchieri & Dimant 2023).

When thoughtfully executed with the above requirements, norm nudges have promise as an intervention tool among adolescents. Marino et al (2020) found that social norms were directly associated with problematic social media use in adolescents and friends' social media use was associated with frequency of social media use. Given this demonstrated peer susceptibility, norm nudges to the desired end - i.e., *many people in your age group believe it's important to limit time on social media* - may be effective as an intervention in schools and other settings for adolescents.

Additionally, in addition to social norms, adolescents are likely to be positively influenced by community focused approaches that similarly harness the power of peer influence. One collective action approach that has shown promise is leveraging peer networks in capacities such as mentoring. A systematic review of peer mentoring for health behavior change (Petosa & Smith 2014) demonstrated the potential for school-based mentoring programs to drive direct improvements for children in skill development, self-efficacy, sense of self-worth, and health outcomes. As other behavioral research has shown the efficacy of enlisting community members as intervention messengers (Abamecha et al 2021), it may be helpful to enlist teachers or even students to help recruit and set up peer mentors for success. A recommended area for future research is to harness the power of peer networks specifically in the context of social media reduction programs, to examine their long-term efficacy, persistence, and impact.

## **II. Precommitment and present bias**



Another promising behavioral intervention for driving behavior change is precommitment. Precommitment involves imposing voluntary constraints on one's future choices (Holzwarth 2018). Present bias leads to obstacles in performing planned actions, creating the widespread behavior of procrastination. O'Brien et al. (2011) and Weigard et al. (2014) found evidence of present bias in adolescents when they asked their study participants to choose between a smaller reward now and a larger reward later. Moreover, Samek et al (2021) surveyed a diverse sample of 500 adolescents on their time and risk preferences and health behaviors. To evoke time preferences, adolescents were asked to make tradeoffs between immediate and long term rewards in the context of a real monetary choice. Adolescents who demonstrated the most time-inconsistency, *i.e. were less patient*, were more likely to have a higher BMI, spend less time playing video games, watching TV, or using the internet, spent less time exercising, and consumed more fast food, soda, and sweets. This suggests that present bias could be a key factor influencing not only problematic social media use, but a variety of other health-related behaviors.

One way to overcome present bias is through precommitment strategies. Schwartz et al (2014) examined the effect of precommitment in helping people make healthier food purchase choices. Study participants in the treatment group precommitted to purchasing a higher percentage of healthy foods each month at the peril of losing a 25% discount. Compared to a control group, the precommitted group bought a significantly higher proportion of healthy items during the 6-month trial period. In the context of adolescents, precommitment has not been as widely studied and merits further research on efficacy. In one of the first studies to measure commitment devices in adolescent populations, Kulendran et al (2016) found that commitment devices delivered via text message were effective in helping adolescents struggling with obesity

to maintain their recent weight loss. To enhance adolescent health and well-being, educators and researchers might want to consider precommitment devices in the context of a variety of behaviors related to health and well-being for adolescents. This is a promising area of future study.

### **Current practices for overcoming cognitive biases with adolescents**

Despite the promise of behavioral and decision sciences, there are many existing approaches to behavior change in adolescents that have fallen short in the past. When attempting to modify adolescent behavior such as social media use, some parents take a punitive approach. Roche et al (2010) examined the link between punitive parenting and adolescent outcomes through a longitudinal study of 1,147 youth. While individual interpretations of punitive measures are affected by contextual factors, results indicated that punitive discipline led to increased depressive and delinquency symptoms.

In a more behavioral approach, Stanley et al (2022) implemented a contingency management (CM) approach involving the delivery of incentives in exchange for reducing screen time across apps. While average participant social media use was reduced by the CM treatment, it was not effective for all participants, suggesting some limitations to incentive-based approaches in social media reduction.

Additional approaches to overcoming cognitive biases among adolescents include fostering critical thinking skills in curriculums. Ennis (1989) posited four instructional approaches for critical thinking: (i) teaching critical thinking as a separate subject; (ii) teaching critical thinking as an explicit goal within subject-matter teaching; (iii) teaching critical thinking as an implicit goal within subject-matter teaching, and (iv) teaching critical thinking as a separate goal parallel to subject-matter teaching. Despite this framework, there is no unified critical

thinking curriculum across American schools. Areas of future research could explore the downstream impact of critical thinking skills on student outcomes to encourage schools to adopt a standardized and scientifically validated approach.

Finally, in addition to the various behavioral interventions proposed above, a promising area of future research for improving decision making in adolescents is the Cognitive Reflection Task (CRT). The CRT is the primary measure of adults' ability to suppress intuitive ("System 1") thinking in favor of an effortful and reflective ("System 2") answer (Frederick 2005). The CRT is specifically designed for adult populations, but Young et. al (2020) developed a version of the CRT for children/adolescents called the CRT-Developmental. They found that the CRT-D was a strong predictor of greater understanding of concepts in math and science, demonstrating the practical power of observing cognitive reflections in developmental populations. If cognitive biases are indeed due to errors in our intuitive "System 1" judgements, strategic testing of the CRT-D in classroom contexts could serve as the impetus for delivering some of the behavioral interventions discussed earlier in this paper. For instance, if a classroom is abnormally low on the CRT-D, it follows that behavioral interventions focused on reducing cognitive biases could improve this trend.

In conclusion, there is growing awareness among policymakers, teachers, and students themselves on the risks and alternatives to social media. Among the complex ecosystem that leads to risk of maladaptive use in adolescents, cognitive biases such as future discounting and social norms may play an important role. In Angela Duckworth's seminal work, *Grit: The Power of Passion and Perseverance*, she adeptly outlines the attributes encompassing talent:

“In the most general sense, talent is the sum of a person’s abilities—his or her intrinsic gifts, skills, knowledge, experience, intelligence, judgment, attitude, character, and drive. It also includes his or her ability to learn and grow.”

I believe this growth mindset is exactly what behavioral and decision scientists should uphold in the realm of judgment and decision making, recognizing it as an essential life skill. Through continuous learning and a growth mindset, children and adolescents can be equipped to better make decisions in a complex and ever-changing world. We all have a responsibility to leverage the learnings of modern behavioral and decision sciences to relentlessly focus on improving adolescent well-being to secure their futures and contributions to society.

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